No information is available on the career intentions of those in postdoctorate positions, but it is often assumed that a postdoc is valued most by academic departments at research universities. However, more postdocs in each field accept employment with for-profit firms than obtain tenure-track positions, and many tenure-track positions are at schools where a research record is not of central importance.

Salaries for Recent S&E Ph.D. Recipients

For all fields of degree, the median salary for recent S&E Ph.D. recipients in 1999 was $49,000, a change of 13.5 percent from 1997. By field, salaries ranged from a low of $34,000 in biological sciences to a high of $75,000 in electrical engineering. (See text table 3-17.) For all Ph.D. recipients, those in the top 10 percent of salary distribution (90th percentile) earned $80,000. The 90th percentile salaries varied by fields, from a low of $60,000 for those in sociology and anthropology to a high of $101,000 for those in computer sciences. At the 10th percentile, representing the lowest pay for each field, salaries ranged from $24,000 for those in biology to $51,000 for those in electrical engineering.

Salaries for recent S&E Ph.D. recipients by sector of employment are provided in text table 3-18. In 1999, the median salary for a postdoc one to three years since receipt of degree was $30,000, less than one-half the median salary for a recent Ph.D. recipient working for a private company ($68,000). Many of the salary differentials between S&E fields are narrower when examined within employment sector. For those in tenure-track positions, median salaries ranged from $38,000 for chemistry to $61,000 for chemical engineering. At private, for-profit companies, median salaries ranged from $54,000 for sociology and anthropology to $82,000 for computer sciences.

Changes in median salaries for recent bachelor's, master's, and Ph.D. graduates (defined here as one to five years since receipt of degree) are shown in text table 3-19. For all S&E fields, median salaries for recent Ph.D. recipients rose 4.7 percent from 1997 to 1999; for bachelor's and master's degree graduates, median salaries rose 0.0 percent and 2.5 percent, respectively. Several individual disciplines reflected larger increases for Ph.D. recipients, including double-digit increases in physics (10.4 percent), mathematics (12.5 percent), computer sciences (12.0 percent), and economics (10.3 percent). A decline in median salaries occurred in biology (–3.7 percent).

Text table 3-17.
Salary distribution for recent doctorate recipients (1–3 years after degree): 1999
(Dollars)

Ph.D. field	Percentile				
	10th	25th	Median	75th	90th
Total	26,100	35,000	48,800	65,000	80,000
Computer sciences	48,000	60,000	75,000	89,000	101,000
Mathematical sciences	35,000	38,000	45,000	60,000	75,000
Life sciences	24,000	28,000	35,000	50,000	67,000
Physical sciences	27,000	35,000	52,000	65,000	76,000
Social sciences	30,000	37,200	45,000	56,000	75,000
Engineering	42,700	56,000	66,700	76,000	88,000

SOURCE: National Science Foundation, Division of Science Resources Statistics (NSF/SRS), Survey of Doctorate Recipients, 1999.

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Age and Retirement

The size of the S&E workforce, its productivity, and opportunities for new S&E workers are all greatly affected by the age distribution and retirement patterns of the S&E workforce. For many decades, rapid increases in new entries led to a relatively young S&E workforce with only a small percentage near traditional retirement ages. This general pic-

Text table 3-16.
What 1997 postdocs were doing in 1999, by field
(Percentages)

Ph.D. field	Postdoc	Tenure-track at four-year institution	Other education job	For-profit job	Government job	Unemployed
All S&E fields	33.8	15.1	16.1	25.0	6.0	1.4
Biological sciences	45.0	13.9	13.9	18.0	5.5	1.8
Chemistry	21.9	6.8	6.9	52.0	5.8	3.5
Engineering	21.1	17.3	11.9	41.2	6.9	1.7
Physics	31.8	7.6	26.4	23.4	7.9	0.0
Psychology	21.2	18.5	23.1	32.8	9.6	0.0

SOURCE: National Science Foundation, Division of Science Resources Statistics (NSF/SRS), merged 1997 and 1999 file from NSF's Survey of Doctorate Recipients.

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Text table 3-18.
Median salaries for recent U.S. doctorate recipients (1–3 years after degree), by sector of employment: 1999
(Dollars)

Ph.D field	Total	Private, noneducational	Government	Tenure-track at four-year institution	Postdoc	Other educational
Total	48,800	68,000	55,000	43,400	30,000	33,000
Computer sciences	75,000	82,000	66,000	53,000	—	60,000
Engineering	66,700	70,000	65,000	56,300	38,000	55,000
Life sciences	35,000	61,000	48,000	42,500	28,000	36,000
Mathematical sciences	45,000	60,500	55,200	39,500	40,000	38,000
Social sciences	45,000	53,000	52,400	40,000	30,500	35,000
Physical sciences	52,000	64,000	58,000	39,400	32,700	39,000

— = Fewer than 50 cases.

SOURCE: National Science Foundation, Division of Science Resources Statistics (NSF/SRS), Survey of Doctorate Recipients, 1999.

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Text table 3-19.
Change in median salaries for S&E graduates one to five years after degree: between 1997 and 1999
(Percentages)

Field of degree	Bachelor's	Master's	Doctorate
All S&E fields	0.0	2.5	4.7
Engineering	7.5	10.0	7.5
Chemical	11.9	5.2	3.1
Civil	5.7	4.2	9.1
Electrical	9.3	9.1	7.1
Mechanical	8.8	2.0	3.3
Life sciences	0.0	6.3	–2.8
Agriculture	0.0	11.3	10.1
Biological sciences	0.0	6.3	–3.7
Computer and mathematical sciences	13.5	7.7	9.7
Computer sciences	9.8	9.1	12.0
Mathematical sciences	3.5	12.5	12.5
Physical sciences	0.0	9.9	8.3
Chemistry	3.7	14.3	2.9
Geoscience	–3.6	–7.7	5.0
Physics	0.0	11.1	10.4
Social sciences	3.8	6.1	7.1
Economics	15.2	0.0	10.3
Political science	7.1	8.1	12.5
Psychology	4.2	1.3	1.2
Sociology and anthropology	4.2	3.3	12.6

SOURCE: National Science Foundation, Division of Science Resources Statistics (NSF/SRS), Scientists and Engineers Statistical Data System (SESTAT), 1997 and 1999.

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ture is rapidly changing as the individuals who earned S&E degrees in the late 1960s and early 1970s move into what is likely to be the latter part of their careers.

The possible effects of age distribution on scientific productivity are controversial. Increasing average age may mean increased experience and greater productivity among scientific workers. Others argue that it can reduce the opportunities for younger scientists to work independently. Indeed, in many fields, scientific folklore as well as actual evidence indicate that the most creative research comes from younger people. Ongoing research on the cognitive aspects of aging and the sociology of science is relevant to this debate but will not be reviewed here.

Age and Implications for the S&E Workforce

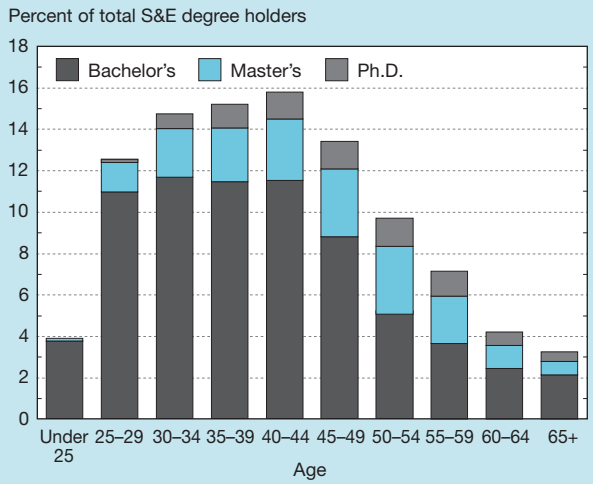
Age distribution among scientists and engineers in the workforce is affected by net immigration, morbidity, mortality, and, most of all, historical S&E degree production patterns. Age distributions for S&E degree recipients in 1999 are given by degree level and broad field of degree in appendix table 3-36. With the exception of new fields such as computer sciences (in which 56 percent of degree-holders are younger than age 40), the greatest population density of individuals with S&E degrees occurs between ages 40 and 49. This is seen in figure 3-17, which shows the age distribution of the S&E-degreed labor force broken down by level of degree. In general, most people in the S&E-degreed labor force are in their most productive years—the late 30s through early 50s, the largest group being ages 40–44. More than one-half of S&E-degreed workers are age 40 or older, and the 40–44 age group is nearly 4 times as large as the 60–64 age group.

This general pattern also holds true for those with Ph.D.s in S&E. Ph.D.-holders are somewhat older than those who have less advanced S&E degrees; this circumstance occurs because there are fewer Ph.D.-holders in younger age categories, reflecting that time is needed to obtain this degree. The greatest population density of S&E Ph.D.-holders occurs for those ages 45 to 54 years.

For all degree levels and fields, only a small portion of the S&E-degreed labor force was near traditional retirement ages: 11.8 percent overall were 55 or older. This circumstance suggests several likely effects on the future S&E labor force that are important and often overlooked:

- Barring large reductions in degree production or similarly large increases in retirement rates, the number of trained

Figure 3-17.
Age distribution of labor force with S&E highest degrees: 1999



See appendix table 3-36. *Science & Engineering Indicators – 2002*

scientists and engineers in the labor force will continue to increase for some time. The number of individuals currently receiving S&E degrees greatly exceeds the number of S&E-degreed workers near traditional retirement ages.

- Barring large increases in degree production, the average age of S&E-degreed workers will rise.
- Barring large reductions in retirement rates, the total number of retirements among S&E-degreed workers will dramatically increase over the next 20 years. This may be particularly true for Ph.D.-holders because of the steepness of their age profile.

Retirement Patterns for the S&E Workforce

The retirement behavior of individuals can differ in complex ways. Some individuals "retire" from a job while continuing to work full or part time, sometimes for the same employer, whereas others leave the workforce without a "retired" designation from a formal pension plan. Three ways of thinking about changes in workforce involvement for S&E degree-holders are summarized in text table 3-20: leaving full-time employment, leaving the workforce, and retiring from a particular job.

By age 62, 50 percent of S&E bachelor's and master's degree-recipients were not employed full time. For S&E Ph.D.-holders, this 50 percent mark was not reached until age 66, three years later. Longevity also differs by degree level when measuring those leaving the workforce entirely: one-half of S&E bachelor's and master's degree-recipients left the workforce entirely by age 65, but Ph.D.-holders did not do so until age 68. Formal retirement also occurs at somewhat higher ages for Ph.D.-holders: more than 50 percent of S&E bachelor's and master's degree-recipients "retired" from employment by age 63 compared with age 66 for S&E Ph.D.-holders.

Data on S&E degree-holders leaving full-time employment by ages 55 to 69 are shown in figure 3-18. For all degree levels, the portion of S&E degree-holders who work full time declines fairly steadily by age. After age 55, full-time employment for S&E doctorate-holders becomes significantly greater than for bachelor's and master's degree-recipients. At age 69, more than 27 percent of S&E Ph.D.-holders work full time compared with 13 percent of bachelor's or master's degree-recipients.

Academic employment may be one reason for a slower retirement rate among Ph.D.-holders. Text table 3-21 shows rates at which S&E Ph.D.-holders left full-time employment by sector of employment between 1997 and 1999.[20] Within each age group (except ages 66–70), a smaller portion of S&E Ph.D.-holders employed in 1997 at four-year colleges or universities or by government left full-time employment com-

[20]As a practical matter, it would be difficult to calculate many of the measures of retirement used previously in this chapter by sector of employment. However, a two-year transition rate can be calculated using the NSF/SRS SESTAT data file matched longitudinally at the individual level.

Text table 3-20.
Retirement ages for holders of S&E highest degrees: 1999

Highest degree	First age at which more than 50 percent are: Not working full time	Not in labor force	Retired from any job
Bachelor's	62	65	63
Master's	62	65	62
Doctorate	66	68	66

SOURCE: National Science Foundation, Division of Science Resources Statistics (NSF/SRS), Scientists and Engineers Statistical Data System (SESTAT), 1999.

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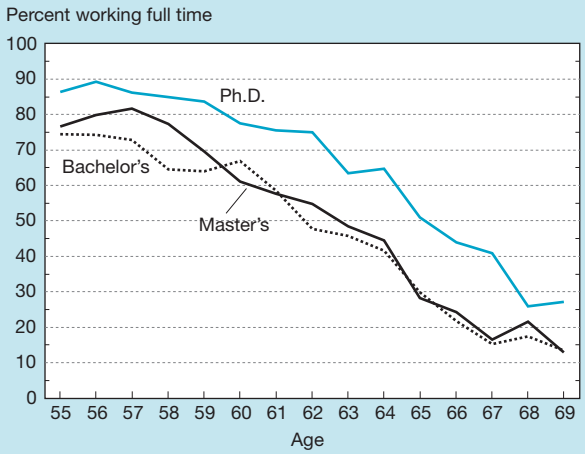
Figure 3-18.
Older S&E degree holders working full time: 1999



See appendix table 3-50. *Science & Engineering Indicators – 2002*

pared with S&E Ph.D.-holders employed by for-profit companies and in all sectors combined.

Although slower retirement for S&E Ph.D.-holders (particularly in academia) is significant and of some policy interest, it is important to recognize that this does not mean that academic or other Ph.D.-holders seldom retire. Indeed, figure 3-18 indicates that their retirement patterns are similar to those for bachelor's and master's degree-recipients; retirement for Ph.D.-holders is just delayed two or three years. Even the two-year transition rates for academia in text table 3-21 show more than 40 percent of those ages 66–70 leaving full-time employment.

Although many S&E degree-holders who formally "retire" from one job continue to work full or part time, this occurs most often among those younger than age 63. (See text table 3-22.) The drop in workforce participation among the "retired" is more pronounced for part-time work; i.e., older retired S&E workers are more likely to be working full time than part time. Retired Ph.D. scientists and engineers follow this pattern, albeit with somewhat greater rates of postretirement employment than shown by bachelor's and master's degree-recipients. See sidebar, "Are Information Technology Careers Difficult for Older Workers?"

Projected Demand for S&E Workers

During the 2000–2010 period, employment in S&E occupations is expected to increase about three times faster than the rate for all occupations. (See text table 3-23.) Although the economy as a whole is expected to provide approximately 15 percent more jobs over this decade, employment opportunities for S&E jobs are expected to increase by about 47 percent (about 2.2 million jobs).

Approximately 86 percent of the increase in S&E jobs will likely occur in computer-related occupations. Overall employment in these occupations across all industries is expected to increase by about 82 percent over the 2000–2010 decade, adding almost 1.9 million new jobs. The number of jobs for computer software engineers is expected to increase from 697,000 to 1.4 million, and employment for computer systems analysts is expected to grow from 431,000 to 689,000 jobs.

Within engineering, environmental engineering is projected to have the biggest relative employment gains, increasing by 14,000 jobs, or about 27 percent. Computer hardware engineering is also expected to experience above-average employment gains, growing by 25 percent. Employment for all engineering occupations is expected to increase by less than 10 percent.

Job opportunities in life science occupations are projected to grow by almost 18 percent (33,000 new jobs) over the 2000–2010 period; at 27 percent (10,000 new jobs), medical science occupations are expected to experience the largest growth. Employment in physical science occupations is expected to increase by about 18 percent (from 239,000 to 283,000 jobs); slightly less than one-half of these projected job gains are for environmental scientists (21,000 new jobs).

Social science occupations are expected to experience above-average growth (20 percent) over the decade largely due to the employment increases anticipated for market and survey researchers (27 percent, or 30,000 new jobs). Demand for psychologists is also projected to be favorable (18 percent, or 33,000 new jobs).

Text table 3-21.
Employed, 1997 S&E doctorate holders leaving full-time employment by 1999: by sector of employment in 1997
(Percentages)

Age in 1997 (years)	All sectors	Four-year schools	For-profit company	Government
51–55	5.6	4.1	6.4	3.9
56–60	9.5	5.1	17.3	5.8
61–65	21.6	18.3	33.5	19.8
66–70	45.1	43.2	38.4	64.7
71–73	32.6	29.7	—	—

— = Insufficient sample size for estimate

SOURCE: National Science Foundation, Division of Science Resources Statistics (NSF/SRS), Scientists and Engineers Statistical Data System (SESTAT), 1997 and 1999.

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Text table 3-22.
S&E-degreed individuals who have "retired" but continue to work: 1999
(Percentages of those retired)

	Highest degree					
	Bachelor's		Master's		Ph.D.	
Age (years)	Part time	Full time	Part time	Full time	Part time	Full time
50–55	12.1	52.9	12.5	66.8	16.9	57.0
56–62	14.4	27.8	21.3	36.9	17.0	38.7
63–70	14.5	8.3	17.1	11.9	19.3	11.6
71–75	8.1	8.4	11.9	3.3	15.2	6.1

NOTE: Retired means those who said they had ever retired from any job.

SOURCE: National Science Foundation, Division of Science Resources Statistics (NSF/SRS), Scientists and Engineers Statistical Data System (SESTAT), 1999.

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The Global S&E Workforce and the United States

"There is no national science just as there is no national multiplication table." —Anton Chekov (1860–1904)

Science is a global enterprise. The common laws of nature cross political boundaries, and the international movement of people and knowledge made science global long before "globalization" became a label for the increasing interconnections among the world's economies. The United States (and other countries as well) gains from new knowledge discovered abroad